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Point of Contact: Nancy Dorigi
(650) 604-3258
ndorigi@mail.arc.nasa.gov

Direct-To Tool for En Route Controllers

Heinz Erzberger, Dave McNally

A new tool that helps air traffic controllers improve the efficiency of trajectories has been developed by researchers at Ames Research Center. The tool, called Direct-To, identifies all the aircraft in a region of airspace that can reduce their time of flight by choosing more direct routes than those originally planned. It was designed to help reduce routing inefficiencies resulting from the fixed highway-in-the-sky route structure and other operational constraints imposed by air traffic control. The software for the tool has been completed and was integrated into the Center-TRACON Automation System (CTAS), which comprises a suite of tools for air traffic controllers. The tool is scheduled for operational tests in mid-year 2001 at the Fort Worth Air Route Traffic Control Center. In preparation for the field test, the tool has been operated at Ames in shadow mode with live air traffic data received from the Fort Worth Center. It has also undergone extensive simulator evaluations with controllers in the loop.

The algorithm in Direct-To first computes four-dimensional trajectories along the planned flight plan routes for all aircraft tracked by radar in a Center's airspace. Then it computes a direct-to trajectory, also referred to as a great circle route, to a trial direct-to way point on the aircraft's flight plan. Finally, it compares the times of the original and the direct-to trajectories leading to the trial direct-to way point

where the two trajectories rejoin. If the direct-to trajectory shows at least a 1-minute time saving over the original trajectory, the aircraft is added to the Direct-To list. This list, which is displayed on the controller's monitor, contains the identifiers of all such aircraft found by the algorithm, ordered by the amount of the time saving, with aircraft showing the greatest saving placed at the top. In addition to finding all aircraft eligible for direct-to flight plan changes, the algorithm analyzes the proposed direct-to route for potential conflicts. If a conflict is predicted to occur, the time to the conflict is added to the list.

The controller interface for Direct-To is based on graphical user interface techniques incorporated in personal computers. It makes extensive use of point-and-click mouse inputs and on-screen graphics and buttons to minimize controller workload. For example, it requires only two mouse clicks to make a direct-to flight plan change, rather than the more than 10 keystrokes a controller has to enter to make the same change in today's system. This reduction in workload, combined with the accurate identification of the most time-saving and conflict-free direct-to trajectories, will make it possible for controllers to issue direct-to clearances to pilots more frequently, thereby yielding substantial cost savings to aircraft operators.

An estimate of the time and cost saving expected from use of the tool has been obtained by running the tool in shadow mode with live traffic input from the Fort Worth Center for a period of several months. It shows a potential saving of about 1,500 minutes of flying time per day. It is equivalent to a saving of 2.5 minutes for the average aircraft eligible for a direct-to clearance. This translates to yearly cost savings of about \$15,000,000 for airlines operating in the Fort Worth Center's airspace. If the tool were implemented at all en route centers in the continental U.S. airspace, the operating cost savings could exceed \$150,000,000. A patent application for the Direct-To tool has been filed with the Patent and Trademark Office.

The figure shows a screen photo of a controller display, which superimposes Direct-To tool

information on a plan view radar display. Ampersands indicate the location of radar targets. Three aircraft are on the Direct-To list, located in the upper right. The controller has selected flight SCX61, which is a departure out of DFW, as a candidate for a direct-to clearance to the fix TXO, with a time saving of 2.6 minutes. The green "OK's" indicate that no conflicts are expected for any of the direct-to-eligible aircraft on the list. The panel at the bottom provides information generated by the Trial Planner. It contains the "ACCEPT" button the controller clicks to confirm the clearance. The direct-to trajectory to TXO is shown in yellow, and the flight plan trajectory with its detour to the south is shown in white.

Point of Contact: Heinz Erzberger
(650) 604-5425
herzberger@mail.arc.nasa.gov

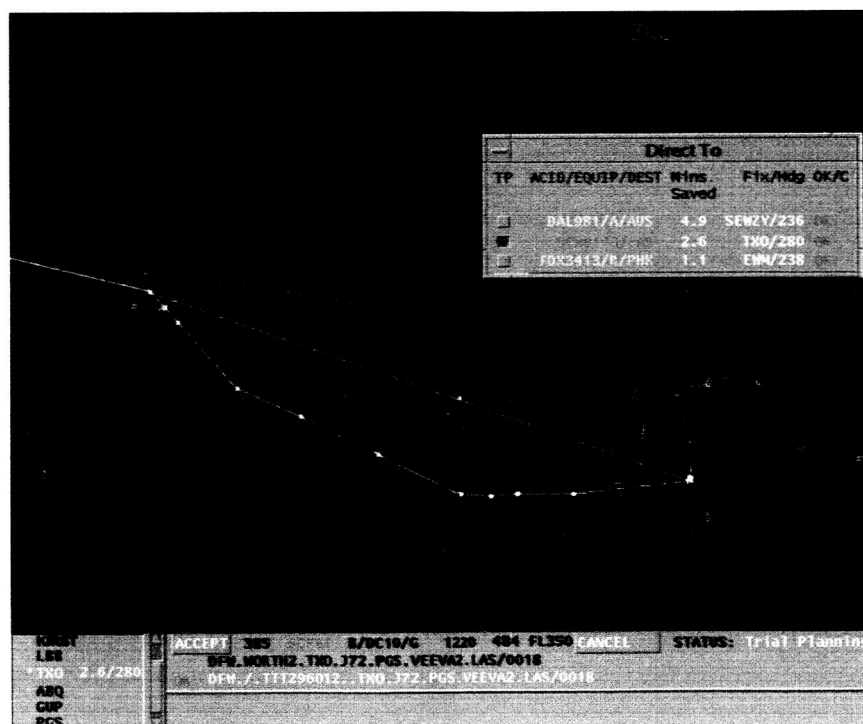


Fig. 1. Photo of Controller display showing Direct-To tool.